GRINDER VEHICLE FOR REMOVING TRAFFIC MARKINGS

FIELD OF THE INVENTION

This invention relates to a grinder vehicle for removing traffic markings from an underlying roadway surface, and more particularly, to such a grinder vehicle having a self propelled drive unit with an engine that drives both the drive unit and a grinder head assembly.

BACKGROUND OF THE INVENTION

Roadways are often constructed from concrete or asphalt materials. Traffic markings, such as painted markings, painted lines, epoxy markings, thermoplastic lines, and tape lines, among other markings, are often applied to roadway surfaces to direct traffic. Occasionally, it becomes necessary to remove traffic markings from roadway surfaces.

Traditionally, traffic line removal has been accomplished by manually propelled grinders. Often these grinders remove the traffic markings at an undesirably slow rate and leave undesirably large indentations in the roadway surface in the areas where the traffic lines have been removed.

Some traffic line removal units have a grinder that is connected to a separate, independently driven self-propelled drive unit. However, although the self-propelled drive unit facilitates movement of the grinder, the motor in the grinder remains relatively small, causing the traffic marking removal rate of the traffic line removal unit to remain undesirably slow. Accordingly a need exists for an improved grinder for traffic lines from an underlying roadway surface.

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SUMMARY OF THE INVENTION

In one embodiment, the present invention is a grinder vehicle for removing traffic markings from an underlying roadway surface. The grinder vehicle includes a drive unit having a frame assembly supported by a plurality of wheels and a drive unit engine that drives at least one of the plurality of wheels. A drive shaft is connected to the drive unit engine. A grinder head assembly is connected to the frame assembly of the drive unit and is driven by the drive shaft of the drive unit engine. The grinder head assembly includes a plurality of grinder heads for removing the traffic markings from the underlying roadway surface.

In another embodiment, the present invention is a grinder vehicle for removing traffic markings from an underlying roadway surface. The grinder vehicle includes a drive unit having a frame assembly supported by a plurality of wheels and a drive unit engine that drives at least one of the plurality of wheels. A drive shaft is connected to the drive unit engine. A grinder head assembly is connected to the frame assembly of the drive unit and includes a main shaft that is driven by the drive shaft of the drive unit engine. A plurality of grinder heads for removing the traffic markings from the underlying roadway surface is mounted to and rotatable by the main shaft of the grinder head assembly. A downward pressure adjuster is connected to the grinder head assembly for varying a downward pressure that each grinder head applies to the traffic markings and the underlying roadway surface.

In yet another embodiment, the present invention is a grinder vehicle for removing traffic markings from an underlying roadway surface. The grinder vehicle includes a drive unit having a frame assembly supported by a plurality of wheels and a drive unit engine that drives at least one of the plurality of wheels. A drive shaft is connected to the drive unit engine. A grinder head assembly is connected to the frame assembly of the drive unit and includes a

main shaft that is driven by the drive shaft of the drive unit engine. A plurality of grinder heads for removing the traffic markings from the underlying roadway surface is mounted to and rotatable by the main shaft of the grinder head assembly. A hydraulic cylinder is connected to the grinder head assembly for varying a downward pressure that each grinder head applies to the traffic markings and the underlying roadway surface. A pivot adjuster is connected to the grinder head assembly for pivotally adjusting the position of the grinder head assembly with respect to the underlying roadway surface.

In still another embodiment, the present invention is a grinder for removing traffic markings from an underlying roadway surface that includes a grinder head assembly and a downward pressure adjuster. The grinder head assembly includes a plurality of grinder heads for removing the traffic markings from the underlying roadway surface. the downward pressure adjuster is connected to the grinder head assembly for varying a downward pressure that each grinder head applies to the traffic markings and the underlying roadway surface.

In another embodiment, the present invention is a grinder for removing traffic markings from an underlying roadway surface that includes a grinder head assembly and a pivot adjuster. The grinder head assembly includes a plurality of grinder heads for removing the traffic markings from the underlying roadway surface. The pivot adjuster is connected to the grinder head assembly for pivotally adjusting the position of the grinder head assembly with respect to the underlying roadway surface.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic perspective view of a grinder for removing traffic markings according to one embodiment of the invention having a drive unit and a grinder head assembly.

FIG. 2 is a schematic representation of a drive unit engine that drives both the drive unit and the grinder head assembly of the grinder for removing traffic markings of FIG. 1;

FIG. 3 is a cutaway view of a frame assembly that houses the grinder head assembly of FIG. 1;

FIG. 4 is a back view of the frame assembly of FIG. 3;

FIG. 5 is a bottom view of the frame assembly of FIG. 3;

FIG. 6 is an exploded view of a grinder head assembly for use in the grinder for removing traffic markings according to one embodiment of the invention;

FIG. 7 is schematic side view of a gear box showing the mating of a drive shaft of the drive unit and a pulley shaft that is connected to the grinder head assembly;

FIG. 8 is a front view of the frame assembly of FIG. 3 showing a pivot adjuster attached thereto for pivotally adjusting the frame assembly; and

FIG. 9 is a side view of the frame assembly of FIG. 8.

DETAILED DESCRIPTION OF THE DRAWINGS

As shown in FIGs. 1-9, embodiments of the present invention are directed to a grinder vehicle for removing traffic markings from an underlying roadway surface. The grinder vehicle includes a self propelled drive unit and a grinder head assembly. The drive unit includes an engine that drives both the drive unit and the grinder head assembly. The grinder head assembly contacts and grinds traffic markings to remove the markings from an underlying roadway surface.

The roadway surface may be any one of a variety of roadway surfaces, such as concrete, asphalt, or asphalt rubber, among other appropriate roadways. The traffic markings may include painted markings, painted lines, epoxy markings, thermoplastic lines, and

tape lines, among other appropriate materials for use as a traffic marker.

FIG. 1 shows a grinder vehicle 10 for removing traffic markings from an underlying roadway surface according to one exemplary embodiment of the present invention. The grinder vehicle 10 includes a self propelled drive unit 12 having a cab portion 14 mounted to a frame assembly 24 of the drive unit 12 and supported by front and rear wheels 30 and 32. The cab 14 includes a seat 16 for receiving an operator (not shown) and a steering mechanism 18 for rotating the front wheels 30 to direct the forward or reserve motion of the grinder vehicle 10. In one embodiment, the steering mechanism 18 includes a typical steering wheel, disposed in close proximity to the seat 16 and connected to a power steering system.

The cab 14 also includes foot pedals. The foot pedals include a control pedal 20 and a brake pedal 22. The control pedal 20 is connected to a hydrostatic drive of a transmission of the drive unit engine 26 (as shown in FIG. 2). The brake pedal 22 is connected to a brake pad of each wheel 30 and 32. Operation of the control and brake pedals 20 and 22 is discussed in detail below.

A housing assembly 42 that supports a grinder head assembly 40 (as shown in FIG. 3) is mounted to and extends forwardly from the frame assembly 24 of the drive unit 12. As shown in FIG. 3, the grinder head assembly 40 includes a plurality of grinder heads 44 for contacting and grinding traffic markings to remove the markings from an underlying roadway surface.

As described in detail below, the housing assembly 42 is moveable relative to the frame assembly 24 of the drive unit 12 to allow the grinder head assembly 40 to move between a grinding position, wherein the grinder heads 44 contact and grind the traffic markings, and a transporting position, wherein the grinder heads 44 are not in contact with the roadway surface.

As shown in FIG. 2, the drive unit engine 26 is connected to the wheels 30 and 32 of the vehicle. In one embodiment, the drive unit engine 26 drives the front wheels 30 of the drive unit 12 in a 2-wheel drive system. In another embodiment, the drive unit engine 26 drives both the front and the rear wheels 30 and 32 of the drive unit 12 in a 4-wheel drive system. Extending from the drive unit engine 26 is a drive shaft 34. The drive shaft 34 enters a gear box 28 (as shown in FIG. 3) and engages and drives a pulley system 36 (as shown in FIG. 3), which in turn drives a main shaft 38 of the grinder head assembly 40 (as shown in FIG. 3.)

In one embodiment, the drive unit 12 is taken from a commercially available lawn mowing tractor, such as a John Deere® 1400 Series Mower, (hereinafter the John Deere® tractor.) The John Deere® tractor includes a drive unit similar to that described above having a cab portion mounted to a frame assembly and supported by front and rear wheels. A mower assembly is mounted to and extends forwardly from the cab portion, which includes a seat for receiving an operator. The mower assembly includes rotary blades for cutting a ground surface. The John Deere® tractor is driven by a drive unit engine having a drive shaft that extends from the drive unit engine to engage and rotatably drive the blades of the mower assembly.

The John Deere® tractor can be modified for use as the drive unit 12 in one embodiment of the present invention by disassembling the mower assembly from the frame assembly of the drive unit, mounting the housing assembly 42 of the grinder head assembly 40 to the frame assembly of the drive unit, and attaching the drive shaft 34 to the gear box 28 to drive the pulley system 36 and the grinder head assembly 40 attached thereto.

Other lawn mowing tractors that are suitable for modification and use as the drive unit 12 in exemplary embodiments of the present invention include lawn mowing tractors made commercially

available by John Deere®, Jacobsen® and Toro® among other appropriate lawn mowing tractors made commercially available by other suitable manufactures and/or distributes. In addition, the drive unit in exemplary embodiments of the present invention may also be taken from other types of tractors and/or motored vehicles.

FIGs. 3-5 show a cut away view, a bottom view and a back view, respectively, of the housing assembly 42 of the grinder head assembly 40. As shown, the gear box 28 is mounted to the housing assembly 42. The gear box 28 houses the pulley system 36. The pulley system 36 includes a pulley shaft 47 connected to a belt 48 that drives the main shaft 38 of the grinder head assembly 40.

The gear box 28 includes an opening 46 that receives the drive shaft 34 of the drive unit engine 26. As shown in FIG. 7, the drive shaft 34 has a gear head 49 that engages a gear head 51 of the pulley shaft 47 to transfer a rotation of the drive shaft 34 to the pulley shaft 47. In the depicted embodiment, the gear heads 49 and 51 are oriented at a 45 degree angle with respect to each other and the diameter and teeth of the gear heads 49 and 51 have a one to one ratio. Preferably, compressible bushings, such as rubber bushings are mounted between the gear box 28 and the housing assembly 42 to reduce vibrations.

A shroud 60 is also mounted to the housing assembly 42. The shroud 60 houses the grinder heads 44 of the grinder head assembly 40. The grinder head assembly 40 includes a plurality of mounting shafts 52. Each mounting shaft 52 extends laterally from the main shaft 38 of the grinder head assembly 40. Each grinder head 42 is rotatably mounted about a perimeter of its corresponding mounting shaft 52. As such, a rotation of the main shaft 38 of the grinder head assembly 40 causes each grinder head 44 to rotate both about the main shaft 38 of the grinder head assembly 40, as shown by arrow 56, and about its corresponding mounting shaft 52, as shown for example by arrow 54.

Each grinder head 44 includes a wheel 55 having a plurality of bits or teeth 58 extending peripherally about an outer perimeter thereof to contact and grind a traffic marking to remove the marking from an underlying roadway surface. In one embodiment, each bit 58 is composed of a tungsten carbide material. The bits 58 contact and grind the traffic markings, while minimizing the grinding of the underlying roadway surface. As shown in FIGs. 3 and 4, the shroud 60 includes a hinged portion 62 that pivots about a hinge 64 to allow for easy access and/or maintenance to the grinder head assembly 40.

In one embodiment, the grinder head assembly 40 is a Rotary Cutter Head Assembly as shown in FIG. 6, which is commercially available from EDCO® (Equipment Development Company.) Each Rotary Cutter Head Assembly includes a hub 120. The hub 120 includes a plurality of side openings 122 which each receive a portion of a corresponding one of the plurality of mounting shafts 52. Each mounting shaft 52 is mounted to the hub 120 by a pin 124. Each mounting shaft 52, in turn, receives a grinder head 44. Each grinder head 44 is mounted on a smooth surfaced portion of the mounting shaft 52 so that the grinder head 44 is rotatable about the mounting shaft 52. Fasteners threadably engage a threaded portion 128 of the mounting shaft 52 to secure the grinder head 44 to the mounting shaft 52. Washers 131 may be mounted adjacent to the grinder heads 44 for protection.

A base plate 130 connects the hub 120 to the main shaft 38 of the grinder head assembly 40 so that the hub 120 (and hence each grinder head 44) rotates when the main shaft 38 rotates. The main shaft includes a laterally extending mounting plate 135. The mounting plate 135 includes openings 138 that are aligned with corresponding openings 132 and 136 in the hub 120 and the base plate 130. Fasteners 134 extend through the openings in the base plate 120, the hub 120 and the mounting plate 135 of the main shaft

38 and engage nuts 140 to secure the hub 120 to the main shaft 38. An inner bushing 142 (such as a rubber bushing) and an outer bushing 144 (such as rubber bushings) are disposed in surrounding relation to the fasteners 134 to reduce vibrations. Each grinder head 44 includes a plurality of bits 58, such as tungsten carbide bits. Preferably each grinder head 44 includes either 24 bits (part number TR3-24) or 48 bits (part number TR3-48.)

Other grinder head assemblies and/or grinder heads that are suitable for use in exemplary embodiments of the present invention include grinder head assemblies and/or grinder heads made commercially available by EDCO® or Smith Manufacturing Company®, among other suitable manufactures and/or distributors.

In one embodiment, the drive shaft 34 is electrically connected to a clutch and is only activated when the clutch is activated. In the embodiment of FIG. 1, the clutch is activated by a toggle switch 73 having on and off positions. The clutch switch 73 is located in cab 14 of the drive unit 12 in close proximity to the seat 16, such as on a column 74 of the steering mechanism 18. In one embodiment, the clutch is an electric magnet clutch.

The rotational speed of the drive unit engine 26 (and hence the rotational speeds of the drive shaft 34, the pulley shaft 47, the pulley belt 48, the main shaft 38 of the grinder head assembly 40 and each grinder head 44) is variable and controlled by varying the position of a control lever 70 disposed in the cab 14 of the drive unit 12 in close proximity to the seat 16 (as shown in FIG. 1). In one embodiment, the more the control lever 70 is moved from an idle position, the faster the rotational speed of the drive unit engine 26.

As shown, in FIG. 1, 8 and 9, a support bar 80 is mounted to the frame assembly 24 of the drive unit 12, such as by mounting plates 82 and fasteners 81 and/or welding. The support bar 80 is rotatably mounted to the mounting plates 82. The housing assembly

42, in turn, is mounted to the support bar 80. In the embodiment of FIG. 8, the support bar 80 includes arms 83 that are mounted to a connecting rod 84 and the housing assembly 42 includes arms 85 that are similarly mounted to the connecting rod 84, such that a movement of the support bar 80 causes a corresponding movement of the housing assembly 42.

As shown in FIGs. 1, 8 and 9, a pivot adjuster 66 is connected to the housing assembly 42 to pivotally adjust the housing assembly 42 and hence the grinder head assembly 40 mounted therein. Pivotally adjusting the grinder head assembly 40 facilitates the grinding of traffic markings from a crowned, angled or otherwise irregular roadway surface.

The pivot adjuster 66 includes a threaded rod 68 having a handle 90 that is disposed in close proximity to the seat 16 of the cab 14 of the drive unit 12. The handle 90 is used to rotate the threaded rod 68 as shown by arrow 91. Rotation of the handle 90 causes the housing assembly 42 to pivot about an axis 95 as shown by arrow 96 and described in more detail below.

The pivot adjuster 66 is connected to both the support bar 80 and the housing assembly 42. The pivot adjuster 66 is connected to a collar 87 that, in turn, is connected to the support bar 80 through a pivot arm 88, which is pivotally connected to the support bar 80. The collar 87 is held to the threaded rod 68 by fasteners 97. The collar 87 has an internal bore that prevents the collar 87 from moving relative to the threaded rod 68 when the handle 90 is rotated.

The pivot adjuster 66 is also connected to the housing assembly 42. The pivot adjuster 66 is connected to the housing assembly 42 by an protruding arm 86 of the housing assembly 42. The arm 86 has internal threads that threadably engage the threads of the threaded rod 68, such that rotation of the handle 90 causes a corresponding movement of the arm 86 along the threaded rod 68.

Thus, rotation of the handle 90 causes a relative movement between the protruding arm 86 of the housing assembly 42 and the collar 87 of the support bar 80. This movement, along with the non-rigid connection of arms 83 and 85, respectively, to the connecting rod 85, which connects the support bar 80 to the housing assembly 42, allows the housing assembly 42 to pivot about the axis 95 as shown by the arrow 96.

As shown in FIG. 9, also connected to the support bar 80 is a hydraulic cylinder 100. The hydraulic cylinder 100 has a shaft portion 101 that is moveable relative to a body portion 103 by the action of hydraulic fluids. The hydraulic cylinder 100 is rigidly mounted to the frame assembly 24 of the drive unit 12, such as by one or more fasteners 104 and/or welding. The hydraulic cylinder 100 is also rigidly mounted to a mounting plate 102 that extends from the support bar 80.

Movement of the shaft 101 of the hydraulic cylinder 100 relative to the body of the hydraulic cylinder 100 causes the mounting plate 102 to rotate the support bar 80 as shown by arrow 112. This, in turn, causes the connecting rod 84 and the housing assembly 42 of the grinder head assembly 40 to corresponding rotate as shown by arrow 112. By varying the force of the hydraulic cylinder 100 exerted on the mounting plate of the support bar 80 the downward pressure, as indicated by arrow 114, that the grinder heads 44 apply to the traffic markings of an underlying roadway surface 110 is varied.

In one embodiment, hoses are connected to the hydraulic cylinder 100 to add or remove hydraulic fluid from the hydraulic cylinder 100. The hoses are connected to a hydraulic control lever 71, which is located in close proximity to the seat 16 in the cab 14 of the drive unit 12. The hydraulic control lever 71 actuates valves connected to the hydraulic fluid hoses to control the amount of hydraulic fluid that is distributed to or removed from the

hydraulic cylinder 100. The hydraulic control lever 71 has a neutral position where the grinder heads 44 are not in contact with the surface to be grinded 110. Moving the hydraulic control lever 71 away from the neutral position causes the hydraulic cylinder 100 to move the grinder heads 44 into contact with the surface 110 to be grinded. Each movement of the hydraulic control lever 71 away from the neutral position increases the downward pressure that the grinder heads 44 apply to the surface 110 to be grinded.

In one embodiment, the hydraulic cylinder 100 can exert up to approximately 1600 psi (pounds per square inch) of pressure. As a result, by movement of the hydraulic control lever 71, the down pressure that the grinder heads 44 apply to the surface 110 to be grinded can vary from zero to approximately 1600 psi.

To drive the grinder vehicle 10 in either the forward or reverse directions, the control pedal 20 must be depressed and the control lever 70 must be moved from an idle position. Depressing the control pedal 20 activates the hydrostatic drive of the transmission of the drive unit engine 26. The control pedal 20 controls the amount of fuel that is distributed to the drive unit engine 26. Thus, the more the control lever 70 is moved from an idle position, the more fuel that is distributed to the drive unit engine 26 and the faster the rotational speed of the drive unit engine 26. To drive the grinder vehicle 10 in a forward direction, a top portion of the control pedal is depressed. To drive the grinder vehicle 10 in a reverse direction, a bottom portion of the control pedal is depressed.

When the grinder vehicle 10 is being driven, the grinder heads 44 can either be activated to grind a surface or deactivated by toggling the clutch switch 73, which controls the drive shaft 34 of the drive unit engine 26. The drive shaft 34 drives the grinder heads 44 as described above. An advantage of having a single drive unit engine 26 that drives both the drive unit 12 and the grinder

head assembly 40 and having the grinder head assembly 40 activated by the actuation of a clutch is that the drive unit 12 can be driven to a desired location while the grinder head assembly 40 remains in a inactivated state. The grinder head assembly 40 can then be activated only when it is desired to grind a surface, increasing the safety of the grinder vehicle 10.

A grinding operation can also be performed when the grinder vehicle 10 is stationary. In order to perform such an operation, the clutch switch 73 is turned to the on position, thus activating the drive shaft 34 of the drive unit engine 26, and the control lever 70 is moved from an idle position, while the control pedal 20 is not depressed. Thus, the grinder head assembly 40 is activated but the hydrostatic drive of the transmission of the drive unit engine 26 is not activated. As such, the grinder head assembly 40 can grind a surface while the grinder vehicle 10 is stationary. As discussed above, the more the control lever 70 is moved from an idle position, the more fuel that is distributed to the drive unit engine 26 and the faster the rotational speed of the drive unit engine 26 (and hence the drive shaft 34 and the grinder head assembly 40 driven thereby.)

In one embodiment, the drive unit engine 26 is a twenty four Horsepower, three cylinder, liquid cooled diesel engine. Such an engine is much larger than engines used in traffic marking removers of the prior art. Using a twenty four horsepower engine allows the drive unit 12 to drive the grinder vehicle 10 to a speed in a range of approximately zero to twelve mph (miles per hour) in the forward direction and to a speed in a range of approximately zero to five mph (miles per hour) in the reverse direction.

Since the control lever 70 controls the speed of rotation of the drive unit engine 26 and the engine 26 drives the grinder heads 44 through the drive shaft 34, the control lever 70 also controls the speed of rotation of the grinder heads 44. Therefore, the

speed of rotation of the grinder heads 44 is also variable. In one embodiment, the drive shaft 34 rotates each grinder head 44 at a speed in the range of approximately 200 rpm (revolutions per minute) to approximately 1600 rpm. Rotating the grinder heads 44 against the traffic markings of an underlying roadway surface at such high rotational speeds allows the grinder vehicle 10 to remove the traffic markings at a much faster rate than other grinders.

As shown in FIG. 1, a water tank 70 and a vacuum (not shown) are each attached to the cab 14 of the drive unit 12. The water tank 70 and vacuum are each connected to a hose 72 and 74 having an opening in close proximity to the grinder head assembly 40. Water from the water tank 70 may be applied in close proximity to the grinder head assembly 40 during a grinding operation to reduce dust from rising in the area above the roadway being grinded. The vacuum hose 74 may be placed in close proximity to the grinder head assembly 40 during a grinding operation to collect the dust that rises in the area above the roadway being grinded. The water tank 70 may be controlled by actuation of a valve and the vacuum may be activated by an electronic switch. The water valve and the electronic switch of the vacuum are each mounted in close proximity to the seat 16 in the cab 14 of the drive unit 12. In addition, as shown, for example in FIG. 1, 3, 4 and 9, a lower portion 65 of the shroud 60 is composed of a compressible material such as rubber. During a grinding operation, the lower portion 65 of the shroud 60 is compressed against the surface being grinded to help control the rising of dust from the surface being grinded.

The preceding description has been presented with reference to various embodiments of the invention. Persons skilled in the art and technology to which this invention pertains will appreciate that alterations and changes in the described structures and methods of operation can be practiced without meaningfully departing from the principle, spirit and scope of this invention.